

aa. Body more elongate and less strongly compressed, the depth 4.75 to 5 in the length; mouth nearly vertical; ventral disk short, reaching only about two-thirds the distance from its origin to the origin of anal..... *eulepis*, p. 327

180. *Microgobius holmesi* Smith. Holmes goby.

Microgobius holmesi Smith, North Carolina Geol. and Econ. Surv., Vol. II, 1907, p. 366, fig. 168; Beaufort, N. C.

Head 3.1 to 3.8; depth 4.7 to 5.4; D. VII or VIII-16 or 17; A. 17; scales about 45. Body elongate, quite strongly compressed; head rather large, compressed; snout short, 3.5 to 4.1 in head; eye 2.95 to 3.3; interorbital very narrow 11.3 to 14; mouth large, very oblique; maxillary reaching under middle of eye, 2 to 2.4 in head; teeth in the jaws simple, those of the upper jaw with an outer enlarged series well separated from an irregular inner series of smaller ones; lower jaw with an outer series of enlarged teeth, well separated from a narrow band of small, inner teeth; gill openings large, the membranes narrowly attached to the isthmus; lateral line indistinct; scales cycloid, present posteriorly, wanting on head and body from about middle of base of first dorsal forward, largest and most distinct on caudal peduncle; dorsal fins well separated, the first consisting of very slender, short spines; second dorsal and anal similar and opposite each other; caudal fin long, pointed, notably longer than head; ventral disk long, reaching to or a little beyond origin of anal; distance from origin of ventrals to origin of anal somewhat shorter than head; pectoral fins rather large, about as long as head, 3.05 to 3.6 in length of body.

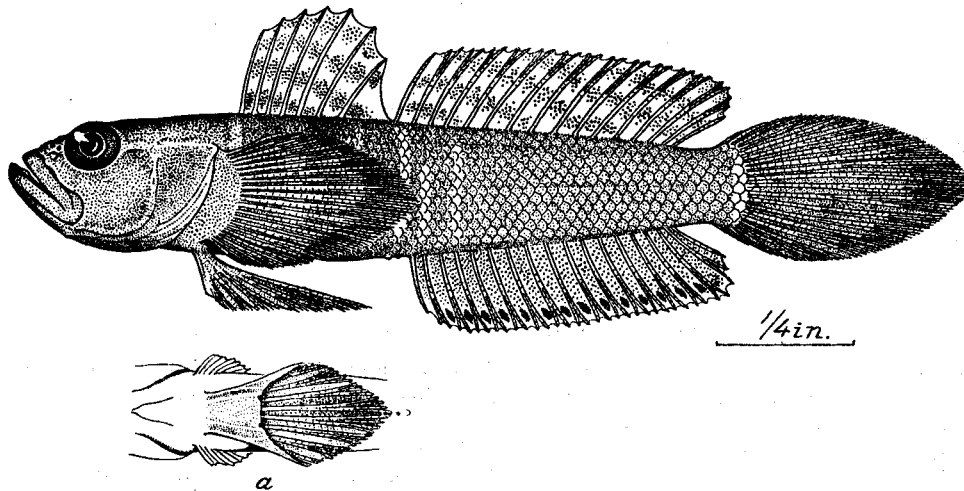


FIG. 196.—*Microgobius holmesi*. Adult, about 2 inches long. a. Ventral disk

Color of a fresh specimen plain light blue; opercle edged with yellowish green; several bluish vertical bars above abdomen; specimens faded to a pale straw color in alcohol, without noticeable markings.

This little goby is represented by 10 specimens, ranging in length from 22 to 47 millimeters ($\frac{7}{8}$ to $1\frac{7}{8}$ inches). It is most readily distinguished from its nearest relative, *M. eulepis*, by its deeper and more compressed body and a longer ventral disk, which reaches to or beyond the origin of the anal; whereas in *M. eulepis* it reaches only about two-thirds the distance from its base to the origin of the anal.

Two stomachs were examined for food. One was empty and the other contained fragments of a small crustacean. The spawning habits of this fish are largely unknown as yet. The senior author, however, took some ripe or nearly ripe fish on July 10, 1914, at Beaufort, N. C. The largest of the ripe fish was 2 inches in length, which probably is about the maximum size attained.

Habitat.—Chesapeake Bay to Beaufort; to date taken only at Lewisetta, Va., and Beaufort, N. C.

Chesapeake localities.—(a) Previous records: None. (b) Specimens in collection: From Lewisetta, Va., taken in a brackish pond on mud and sand bottom on August 6 and 8, 1921. Not seen elsewhere.

181. *Microgobius eulepis* Eigenmann and Eigenmann. Scaled goby.

Microgobius eulepis Eigenmann and Eigenmann, Proc., Calif. Ac. Sci., 1898, p. 69; Fortress Monroe, Va. Jordan and Evermann, 1896-1900, p. 2244; Evermann and Hildebrand, 1910, p. 163.

Head 3.9 to 4; depth 4.75 to 5; D. VII, 16; A. 17; scales probably about 50. Body elongate, slender, moderately compressed; head moderately large; snout short; 2.2 to 2.5 in head; eye 3.1 to 3.4; interorbital very narrow, 10.6 to 12.1; mouth large, nearly vertical; maxillary reaching nearly opposite anterior margin of pupil, 2.1 to 2.25 in head; teeth in the jaws simple, in narrow bands, with the outer ones in each jaw somewhat enlarged; gill openings large, the membranes narrowly attached to the isthmus; lateral line not visible; scales cycloid, wanting on head and body in advance of first dorsal; dorsal fins well separated, the first consisting of low flexible spines; second dorsal and anal similar and opposite each other; caudal fin moderately long and pointed, a little longer than the head; ventral disk rather short, reaching only about two-thirds the distance from its base to origin of anal; distance from origin of ventrals to origin of anal slightly longer than head; pectoral fins large, 3.65 in length of body.

Color of a fresh specimen pale bluish; head below eye bright greenish; a bright bluish blotch on abdomen behind pectoral fin; first dorsal pale, edged with black and yellow; second dorsal red at base, yellow in middle, and with a pale outer edge; other fins plain. The alcoholic specimens at hand have faded to a nearly uniform pale color.

Only two specimens of this goby of equal length—namely, 50 millimeters (2 inches)—are at hand. The most noticeable differences between this species and *M. holmesi*, as pointed out in the discussion of the last-mentioned species, are the differences in the shape and depth of the body and the length of the ventral disk. When specimens are compared, it is evident, also, that the mouth in *M. eulepis* is much more vertical, but this character is difficult to describe and to use unless both species are at hand.

Smith (1907, p. 368) reports that a female distended with nearly ripe eggs was taken on May 18, 1905, at Beaufort, N. C. This is all that is known about the spawning of this goby. The specimens at hand, which are 2 inches in length, appear to be the largest known. The species appears to be a rare one.

Habitat.—Chesapeake Bay to Beaufort, N. C.

Chesapeake localities.—(a) Previous records: Fortress Monroe and the mouth of Hampton Creek, Va. (b) Specimens in collection: From the mouth on the Patuxent River, Md.; both specimens at hand were taken on April 28, 1922, one with a beam trawl operated from the *Fish Hawk*, and the other along the beach with a 30-foot collecting seine. A third specimen, which has not been seen by us, is recorded in field notes by Lewis Radcliffe and was taken in a tow net operated from the *Fish Hawk* near Cape Charles, Va.

141. Genus MUGILOSTOMA gen. nov.

Type *Mugilostoma gobio* sp. nov.

Body elongate, more or less compressed; head compressed; gill openings quite large, the membranes rather narrowly connected with the isthmus; mouth moderate, with weak jaws; the lower jaw thin and angular anteriorly, shaped as in the mullets (*Mugil*); teeth movable, in a single series, set on the edge of the thin jaws; ventral fins probably united, forming a sucking disk. (The membrane connecting the fins in the specimen at hand apparently is broken, being still present, however, at the base of the fins. A membranous cross fold, forming a part of the sucking disk, is quite evidently present.)

182. *Mugilostoma gobio* sp. nov.

Type No. 87656, U. S. National Museum; length 27 millimeters; Lynnhaven Bay, Va.

Head 4; depth 5.25; D. VI-11; A. 12; scales about 30. Body very elongate, compressed, tapering gradually toward the tail; caudal peduncle 2.4 in head; head moderate, somewhat deeper than broad; snout very short, 6 in head; eye 2.9; interorbital very narrow, 10.6; mouth rather large, oblique; lower jaw slightly in advance of the upper, very thin, without evident lips, and angular anteriorly as in the mullets (*Mugil*); maxillary very narrow, reaching about middle of eye, 2.65 in head; teeth simple, movable, in a single series on edge of each jaw; gill openings mod-

erately large, the membranes rather narrowly attached to the isthmus; scales quite large, ctenoid, lost on anterior part of body in the specimen in hand, therefore making the number counted for a lateral series uncertain; dorsal fins well separated, the first consisting of very slender, flexible spines; second dorsal and anal similar and opposite each other and separated from the caudal by a distance equal to the greatest depth of the body; caudal fin somewhat pointed, 3.5 in length of body; ventral fins probably united (the membrane apparently is broken in the specimen in hand, the fins however, being still connected at base; a cross fold of skin, forming a part of the sucking disk, is quite evident), reaching about two-thirds the distance from their bases to origin of anal, 1.25 in head; pectoral fins moderately large, the middle rays longest, about as long as head.

Color in alcohol brownish above, somewhat paler underneath; sides with irregular, large, brown blotches, darker than the ground color; base of caudal with two quadrate black spots, one on the upper half of the base and the other on the lower half; the fins otherwise slightly dusky to colorless.

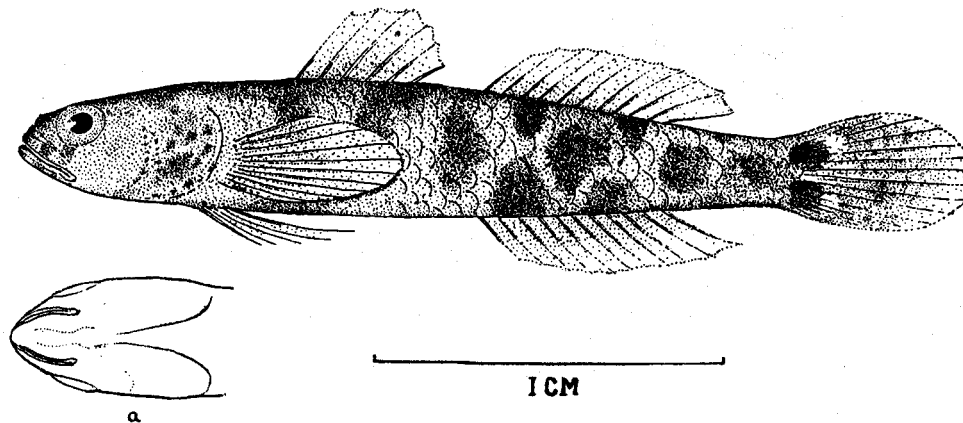


FIG. 197.—*Mugilostoma gobio* gen. et. sp. nov. From the type, 27 millimeters long. a. Ventral surface of head, showing mulletlike mouth

A single specimen of this singular fish, 27 millimeters ($1\frac{1}{4}$ inches) in length, is at hand. It seems to differ from all other gobies known from American waters in the thin, triangular lower jaw, which is shaped and formed as in the mullets (*Mugil*). The teeth differ from all other gobies of Chesapeake Bay in being set in a single series on the outer edge of the lower jaw and in being movable.

Chesapeake localities—Brackish marsh, connected with Lynnhaven Bay, Va., by a creek; taken in a small collecting seine in company with *Fundulus ocellaris*, September 26, 1921.

Order DISCOCEPHALI

Family LXXXI.—ECHENEIDIDÆ. The remoras

Body elongate or slender; head depressed above, with a large oval disk consisting of crosswise partitions or laminae and a single lengthwise septum; lower jaw projecting beyond upper; mouth wide; teeth villiform, present on jaws, vomer, palatines, and usually on tongue; gill arches 4; gill membranes free from the isthmus; branchiostegals 7; scales minute, cycloid; air bladder wanting; dorsal and anal fins long and low; ventral fins thoracic; pectoral fins placed high.

142. Genus ECHENEIS Linnæus. Remoras; Shark suckers

Body slender, fusiform, disk long, with 20 to 28 laminae; soft dorsal with numerous short rays; anal similar, the anterior rays somewhat elongate; caudal slightly concave behind; ventrals long, the inner rays narrowly adnate to abdomen; pectorals pointed, the rays soft and flexible.

183. *Echeneis naucrates* Linnæus. Pilot fish; Shark's pilot; Shark sucker; Remora.

Echeneis naucrates Linnæus, Syst. Nat., ed. X, 1758, p. 261; Indian Ocean. Jordan and Evermann, 1896-1900, p. 2269, Pl. CCCXXIX, fig. 796.

Leptecheneis naucrates Uhler and Lugger, 1876, ed. I, p. 138; ed. II, p. 117.

Echeneis naucratoides Uhler and Lugger, 1876, ed. I, p. 138; ed. II, p. 118.

Head 5.25 to 5.45; depth about 8 to 10; D. 28 to 34; A. 30 to 32. Body elongate, more or less cylindrical; head depressed above; sucking disk large, with 20 or 21 laminae; snout broad, flat, 1.95 to 2 in head; eye 5.05 to 5.15; interorbital 1.65 to 1.8; mouth broad, superior; lower jaw strongly projecting, angulate at tip; maxillary reaching anterior nostril, 2.65 to 2.8 in head; teeth in jaws in broad villiform bands, those in lower jaw mostly exposed; dorsal fin long, somewhat elevated anteriorly; caudal fin posteriorly nearly straight; anal fin similar to dorsal and opposite it; ventral fins rather long and narrow, the inner ray of each fin connected by membrane at base; this membrane on median line attached to abdomen by another membrane; pectoral fins moderate, pointed, the upper rays being longest, 1.1 in head.

Color in alcohol dark brown on back; sides lighter brown; belly still lighter; sides with a dark, longitudinal band; dorsal fin black, anteriorly at least with a pale margin; caudal fin black, the tips of outer rays pale; anal fin dusky brown with a broad pale margin; ventrals dusky brown; pectorals black.

Four specimens of this species, ranging in length from 390 to 485 millimeters (15½ to 19¼ inches) are at hand. This is the only remora known from Chesapeake Bay. It is most readily recognized by the very slender body, the long sucking disk on top of the head, which has 20 or more pairs of transverse plates, and by the long, pointed, projecting lower lip.

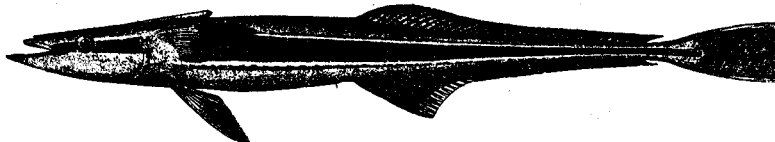


FIG. 198.—*Echeneis naucrates*

This remora is reported to reach a length of nearly 3 feet. It is usually found attached to sharks and occasionally to turtles and other large aquatic animals, but it also swims independently, and sometimes it is taken with hook and line. The remoras are not parasitic on the animals to which they attach themselves by means of the large sucking disk over the head, for this is only their method of "stealing a ride." *E. naucrates* apparently is rare in Chesapeake Bay, possibly because sharks, too, are rather uncommon. Only four specimens were seen during the present investigation, and these were all found in two pound nets on the same date.

Habitat.—All warm seas; northward to Massachusetts Bay on the Atlantic coast of the United States.

Chesapeake localities.—(a) Previous records: "Chesapeake Bay" and "southern parts of Chesapeake Bay" (Uhler and Lugger, 1876). (b) Specimens in collection: Taken on June 15, 1921, all from two pound nets operated in Lynnhaven Roads, Va.

Order JUGULARES

Family LXXXII.—URANOSCOPIDÆ. The stargazers

Body elongate, conic, more or less compressed; widest and usually deepest at occiput; head large, broad, partly covered with bony plates; eyes small, superior, placed anteriorly; mouth vertical; teeth moderate, present on jaws, vomer, and palatines; premaxillary protractile; maxillary broad, without a supplemental bone; gill openings wide; gill membranes nearly separate, free from the isthmus; gills 3½, a slit behind the last; pseudobranchiæ present; branchiostegals 6; scales, if present, small; spinous dorsal small or wanting, the soft dorsal long; caudal fin not forked; anal fin large; ventral fins jugular, close together, with I, 5 rays; pectoral fins large, broad, with oblique bases, the lower rays rapidly decreasing in length.

143. Genus *ASTROSCOPUS* Brevoort. Electric stargazers

Body robust; upper surface of head not entirely covered with bone, the occipital plate ceasing far behind eyes; a bony Y-shaped process on head, the forks of the Y reaching forward to inter-orbital, the vertical limb extending backward to occipital plate; the area between the forks of the Y and extending forward to upper lip covered by naked skin; a somewhat quadrangular naked area on each side of the Y covering the electric organs; head smoother in the adult, in young individuals largely covered with bone and with spines; anterior nostril round, situated in front of eye, fringed; posterior nostril represented externally as a crescent-shaped groove, terminating behind eye, fringed; lips fringed; back and sides covered with close-set scales in adult; first dorsal with four or five short, pungent spines.

184. *Astroscopus guttatus* (Abbott). Electric toad; Stargazer.

Uranoscopus guttatus Abbott, Proc., Ac. Nat. Sci., Phila., 1860 (1861), p. 365, Pl. VII; Cape May, N. J.

Astroscopus anoplus Uhler and Lugger, 1876, ed. I, p. 99; ed. II, p. 83.

Astroscopus guttatus Jordan and Evermann, 1896-1900, p. 2310; Evermann and Hildebrand, 1910, p. 163.

Head 2.4 to 2.7; depth 2.7 to 3.55; D. IV or V-13 or 14; A. I, 12. Body robust, anteriorly quite as wide as deep, posteriorly compressed; head broad, flat above; snout very broad and short, 4.5 to 5.3 in head; eye superior, very small, 5.75 to 13; interorbital very broad, 3 to 3.95; mouth broad, vertical; lower jaw forming anterior margin of head; both lips provided with fringes; nostrils provided with shorter fringes; an elliptical area between and behind eyes with a double row of fringes; maxillary broad posteriorly, reaching under or beyond the eye, 1.95 to 2.15 in head; teeth small, in bands on jaws, also present on vomer and palatines; scales very small, not evident on head, chest, and abdomen; upper part of head largely rough and bony, this sculpture forming a Y on anterior part of head, the limbs of this Y a little longer than the straight part, the straight portion of the Y very wide, as broad as eye; total length of the Y shorter than interorbital, 4.73 to 5.2 in head; a somewhat quadrate naked area present on each side of the Y, these areas being the seat of electric organs; two very short, blunt spines on edge of snout in front of eye; dorsal fins separate, the first composed of short, sharp spines; second dorsal much higher; caudal fin with somewhat convex margin; anal fin more or less enveloped in skin, especially in the adult; ventral fins inserted at the throat, under the anterior part of gill opening, some of the rays distally more or less free; pectoral fins large, the lower rays short, the longest ones 1.05 to 1.3 in head.

Color of a fresh specimen, 280 millimeters in length, largely dusky above; dirty white underneath; upper half with many small, irregular, white spots, increasing somewhat in size posteriorly, extending backward on upper part of side to end of second dorsal (in most specimens at hand the spots do not extend as far back on body as the end of second dorsal). Upper part of caudal peduncle with five irregular whitish blotches; caudal peduncle laterally with an irregular, dark, longitudinal band; lower half of sides with obscure dark blotches; each side of chin with a large black blotch; membranes of spinous dorsal black, with a few pale stripes; second dorsal anteriorly at base with pale spots similar to those on body, the fin with alternating black and white bars; caudal with similar alternating bars; anal fin pale, with a single black bar; ventral fins mostly pale, with dusky points on distal parts; pectorals brownish, base of upper rays with white spots like body, distal parts black. The color varies considerably as to shade among specimens, but the general pattern in adults is about as described. The smallest specimen (60 millimeters) at hand bears no pale spots, and in spirits the upper parts are uniform brownish.

The stargazer is represented by 29 specimens, ranging in length from 60 to 310 millimeters ($2\frac{3}{8}$ to $12\frac{1}{4}$ inches). They evidently are all of one species, regardless of the fact that much variation in color exists among individuals of even size, and more pronounced differences among those of uneven size. The specimens here described have been compared with others from Beaufort, N. C., and we find a distinct difference in the shape of the Y on the head. In the Chesapeake specimens it is notably shorter and broader than in Beaufort specimens, and the straight part is slightly shorter than one of the limbs, while the reverse is true in the Beaufort specimens. The total length of the Y in Chesapeake specimens is shorter than the width of the interorbital space. In Beaufort fish the total length of the Y is equal to or slightly greater than the width of the interorbital space. The following table of measurements illustrates some of these differences. Three specimens from each locality were measured.

	Chesapeake Bay			Beaufort		
	I	II	III	I	II	III
Total length of Y in head	4.73	4.94	5.20	3.24	3.44	3.78
Total length of Y in interorbital	1.21	1.24	1.35	.82	.88	.90
Length of straight part of Y in head	9.50	9.60	10.80	5.25	5.90	6.15
Length of limb of Y in head	6.80	7.75	8.25	7.38	8.35	9.20
Width of straight part of Y in head	10.00	11.15	13.20	18.50	20.50	22.00

The other alleged differences pointed out by Jordan and Evermann (1896-1900, pp. 2307-2310) between the northern stargazer, *A. guttatus*, and the southern one, *A. y-gracum*, namely, that the two spines in front of the eye are longer in the northern species and that the pale spots are smaller, can not be substantiated. All Chesapeake Bay records quite certainly are referable to *A. guttatus*.

The stargazer is readily separated from all other fish of Chesapeake Bay by the broad head, with the very small eyes situated on top of it (from which the name "stargazer" originated), and by the vertical mouth and fringed lips. The rather rough and bony upper surface of the head, with sculpturing forming a Y, also is very characteristic.

The electric toad receives its name from the shock it is able to give to the one who handles it. This shock is produced by electric organs situated in the smooth, naked areas lying posterior to the eyes. A fish 6 inches in length is able to give a very perceptible shock, and larger fish give a proportionately stronger one. It is not yet known

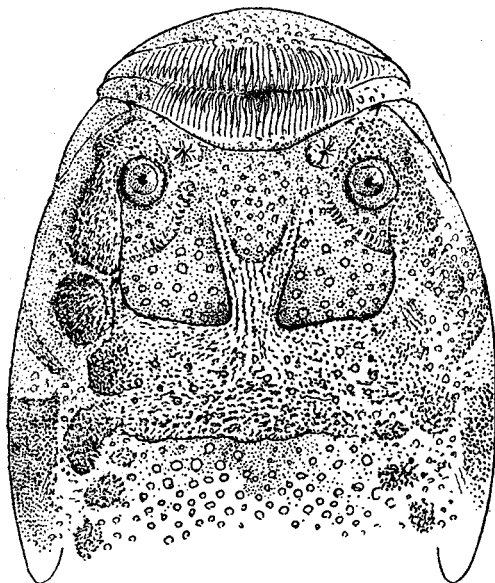


FIG. 200.—*Astroscopus guttatus*. Dorsal surface of head; from a specimen $9\frac{1}{4}$ inches long

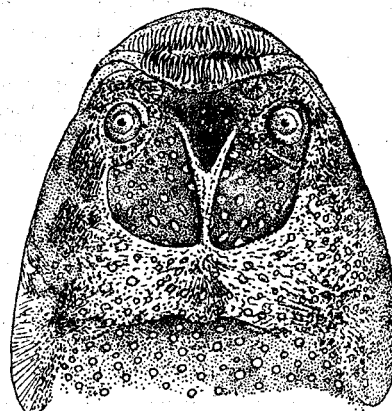


FIG. 199.—*Astroscopus y-gracum*. Dorsal surface of head; from a specimen $7\frac{1}{4}$ inches long

whether use is made of the electric organs in the capture of food or in self-defense, or both.

Six fish, ranging in length from $4\frac{1}{8}$ to $5\frac{1}{8}$ inches, were examined for food. Four of these had fed on fish and two on isopods. This fish lives well in the aquarium, and when sand is provided buries itself, leaving only the eyes and lips exposed. When it is thus buried it is said to be lying in wait for prey. It can live for a long time out of water; one specimen, placed on ice, remained alive for 15 hours.

Very little is known of the spawning habits and rate of growth of this stargazer. Very young

fish are rare in collections. Bean (1903, p. 659) records a specimen 1 inch long, taken on August 1 at Ocean City, N. J., and another, $2\frac{1}{2}$ inches long, caught on August 26 at Longport, N. J. The smallest specimen in the Chesapeake collection—60 millimeters ($2\frac{3}{8}$ inches) long—together with another 93 millimeters ($3\frac{3}{4}$ inches) in length, were seined at Buckroe Beach, Va., on October 5, 1921. At Ocean View, Va., 23 small stargazers were caught in collecting and commercial haul seines from September 25 to October 18, 1922. One of these fish was 151 millimeters (6 inches)

long, and the others ranged from 91 to 138 millimeters ($3\frac{3}{8}$ to $5\frac{1}{2}$ inches) in length. The foregoing catches were made on 11 dates, the greatest number of fish in one haul being five. Adult fish were observed by us in pound-net catches on May 25 and throughout November at Lynnhaven Roads, and again on October 22 at Lewisetta, Va. In the lower parts of the bay more fish were caught during November than at any other period, the latest catch observed having been taken on November 29; but it is taken occasionally throughout the summer. The species is nowhere abundant. It is eaten by the colored fishermen in at least one locality.

The largest specimen at hand, having a length of $12\frac{1}{4}$ inches, may represent about the maximum size attained.

Habitat.—New York to Virginia.

Chesapeake localities.—(a) Previous records "occurs occasionally in the southern part of Chesapeake Bay" (Uhler and Lugger, 1876), Norfolk and Gloucester Point, Va. (b) Specimens in the collection: Lewisetta, Buckroe Beach, Lynnhaven Roads, and Ocean View, Va.

Family LXXXIII.—BLENNIIDÆ. The blennies

Body moderately or greatly elongated, more or less compressed; mouth usually small, sometimes large, never vertical; teeth various; no spines on head; skin naked or covered with small or moderate-sized cycloid or ctenoid scales; lateral line single, double, or absent; dorsal fin very long, the anterior part and sometimes the entire fin with spines; caudal fin sometimes connected with dorsal and anal, sometimes free; usually round; anal fin similar to posterior part of dorsal; ventral fins small or wanting; placed far forward (jugular) if present, composed of one spine and one to three soft rays; pectorals varying from large to rudimentary. Three genera of this family of small to medium-sized fishes are reported from Chesapeake Bay.

KEY TO THE GENERA

- a. No fanglike or canine teeth in posterior part of either jaw; gill openings small, restricted to the sides, the membranes broadly united with the isthmus.
 - b. Head rather pointed; snout well in advance of the forehead; upper margin of eye with or without a small tentacle.....Chasmodes, p. 332
 - bb. Head very blunt; snout only a little in advance of forehead; upper margin of eye with a well developed tentacle.....Hypsoblennius, p. 334
- aa. A fanglike tooth on each side of lower jaw; gill openings wide, the membranes free from the isthmus, or at least forming a fold across it.....Blennius, p. 335

144. Genus CHASMODES Cuvier and Valenciennes. Blennies

Body oblong, compressed; head rather pointed; mouth large; maxillary extending to or beyond posterior margin of the eye; premaxillaries not protractile; teeth rather long, slender, in a single series, present only on front part of jaws, no canines; gill openings very short; scales wanting; a small tentacle on upper part of eye present or wanting; dorsal fin anteriorly, with very slender spines; caudal fin round, either united to or free from the dorsal; anal fin similar to soft part of dorsal; ventral fins jugular, with I, 3 rays; pectoral fins large. A single species is known from Chesapeake Bay.

185. *Chasmodes bosquianus* (Lacépède). Banded blenny.

Blennius bosquianus Lacépède, Hist. Nat. Poiss., II, 1800, p. 493; South Carolina.

Chasmodes quadrfasciatus Uhler and Lugger, 1876, ed. I, p. 98; ed. II, p. 81.

Chasmodes bosquianus Lugger, 1877, p. 70; Bean, 1891, p. 85; Jordan and Evermann, 1896-1900, p. 2394; Evermann and Hildebrand, 1910, p. 163.

Head 3.25 to 3.7; depth 2.9 to 3.8; D. XI or XII, 18 to 20; A. 18 to 20. Body compressed, deepest slightly behind base of pectorals; head compressed, with moderately convex upper profile; snout not very blunt, 3.15 to 3.65 in head; eye moderate, lateral, 2.55 to 4.6; interorbital convex the bone 9.8 to 11; mouth moderately large, a little oblique, terminal; maxillary reaching nearly or quite to posterior margin of eye, 1.6 to 2.2 in head; teeth present only on anterior part of jaws, in a single series, pointed and curved inward at tips; gill opening restricted to the side, not much longer

than the eye; a minute tentacle sometimes present on upper margin of the eye; dorsal fin very long, slightly joined to the caudal, its origin over the concealed margin of the preopercle; caudal fin round; anal fin long and low, distinct from the caudal, its origin under the first soft rays of the dorsal; ventral fins very narrow, inserted in advance of pectorals; pectoral fins broad, 1 to 1.35 in head.

Color of female in alcohol brownish; some individuals much darker than others; sides with pale crossbars or sometimes simply with whitish blotches; frequently also with irregular dark bars or blotches; sometimes with more or less wavy longitudinal lines; head above with very small dark dots; the fins dark spotted or barred; base of caudal with an obscure dark spot. Color of adult males usually darker and more uniform; sides with pale, wavy lines, sometimes with roundish pale spots, somewhat broader than the lines, situated in the course of the lines; upper part of head with small dark dots; fins mostly dark brown, with pale dots; spinous dorsal with a black spot between the first and second spines and frequently with smaller dark spots and dots, usually with a pale longitudinal stripe; no spot at base of caudal. The young resemble the adult female, being somewhat lighter in color, however, and having larger pale spots and bars.

Many specimens of this species, ranging in length from 25 to 90 millimeters (1 to 3½ inches), were preserved and were before the writers when the foregoing description was prepared. The comparatively great variation in color between the sexes and among examples of the same sex is indicated in the description. The sexes, because of the dissimilarity in color, have several times been described as different species. The banded blenny is most readily distinguished from other blennies of Chesapeake Bay by the comparatively pointed snout, the very small and frequently absent tentacle on the upper margin of the eye, and the convex interorbital.

The food, as shown by the contents of 18 stomachs, consists of small crustaceans, small mollusks, and insect larvæ. The small crustaceans, which constituted by far the greater portion of the food, were principally isopods and amphipods.

Spawning takes place from April to August. The eggs apparently are deposited in shells and probably on other objects, to which they adhere. On May 22, 1922, at Cherrystone Island, Va., a "nest," consisting of both valves of an oyster shell with almost the entire inside of the shell covered with eyed eggs, was picked up by hand. It so happened that the parent fish (the male) was inclosed in the shell as it was taken from the water. The nest and the fish were placed together in a bucket containing water. Even under these conditions the male fish remained close to the nest and could scarcely be driven away. Later the nest and the fish were preserved and are now before us.

In this connection the following quotation from Lugger (1877, p. 70) is of interest:

This peculiar little fish seems to be rather common in many parts of the Chesapeake Bay in localities where oysters are found. All the specimens were obtained from different oyster bars, and invariably inhabiting the dead and empty oyster shells called "snuffboxes." When taken out of their retreat they move about very slowly in the water but show great activity when disturbed. They drop from the shell very promptly as soon as the oyster is taken out of the water.

This blenny is reported to reach a maximum length of 4 inches. The largest individual seen during the present investigation, however, did not exceed 3½ inches. The banded blenny is not rare in Chesapeake Bay. On the other hand, it was never taken in large numbers. It was found to be most common in the lower York, Rappahannock, Potomac, and Patuxent Rivers, the largest catches being made from July to October. The latest catch made alongshore was on November 23 at Cape Charles. It was taken on clay, mud, and sand bottom. A few specimens were taken by the *Fish Hawk* during the winter months in water ranging from 9 to 15 fathoms in depth. The species, of course, is too small to be of commercial value.

Habitat.—New York to Florida; rare north of Maryland.

Chesapeake localities.—(a) Previous records: St. Marys River and near the mouth of the Potomac River (Uhler and Lugger, 1876); many parts of Chesapeake Bay, where oysters are found (Lugger, 1877), Blackstone Island, Md., and Cape Charles city, Va. (b) Specimens in collection: Many localities from Annapolis, Md., to Cape Charles and Lynnhaven Bay, Va.

145. Genus *HYPSOBLENNIUS* Gill. Blennies

Body elongate, compressed; head short, its profile steep; snout blunt; mouth small, horizontal; maxillary extending about to middle of eye; teeth slender, in a single series in each jaw, no canines; gill openings reduced, restricted to the sides; skin naked; a tentacle on upper margin of eye; dorsal fin long, the anterior part with slender, pungent spines; caudal round; anal somewhat similar to soft part of dorsal; ventrals inserted under the throat, with I, 3 rays; pectorals rather large. One species is known from Chesapeake Bay.

186. *Hypsoblennius hentz* (LeSueur). Blenny; Spotted seaweed fish.

Blennius hentz LeSueur, Journ., Ac. Nat. Sci., Phila., IV, 1825, p. 363; Charleston, S. C.

Hypsoblennius punctatus Bean, 1891, p. 85.

Hypsoblennius hentz Jordan and Evermann, 1896-1900, p. 2390, Pl. CCCXXXIX, fig. 823; Evermann and Hildebrand, 1910, p. 163.

Head 3.35 to 3.75; depth 2.95 to 3.3; D. XII, 13 to 15 (usually 15); A. 17 to 19 (usually 18). Body compressed, deepest over pectorals, tapering gradually from there to the tail; head short and deep, its anterior profile very steep; snout short, not much in advance of forehead, 2.8 to 3.25 in head; eye placed high, lateral, 3.15 to 3.8; interorbital deeply concave, the bone 7.8 to 10.4; mouth broad, terminal, horizontal; maxillary reaching below middle of eye, 2.5 to 3.05 in head; teeth in jaws only, in a single close-set series, slightly flattened and curved inward; each nostril

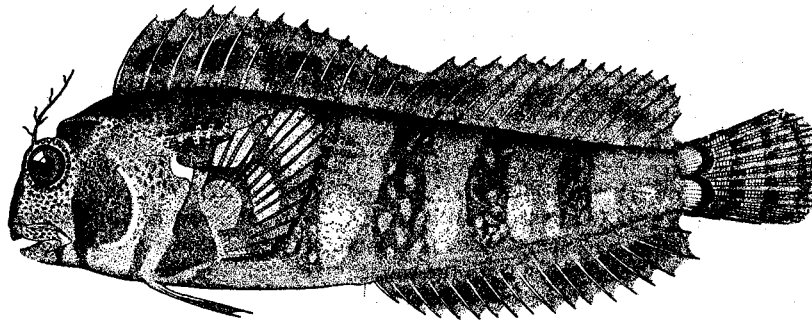


FIG. 201.—*Hypsoblennius hentz*. Adult, $4\frac{1}{4}$ inches long

with a simple, short, fleshy tentacle; a branched tentacle on upper margin of eye, this tentacle sometimes shorter than eye and sometimes more than twice the length of eye (it seems probable that this tentacle is longer in males than in females, yet a very large variation in its length exists among individuals of the same sex); gill openings restricted to the sides, about twice as long as eye; dorsal fin long, continuous, the spines slender but pungent, not quite as high as the soft part of fin, slightly attached to base of caudal; caudal fin round; anal fin lower than soft dorsal, free from caudal, its origin under posterior spines of dorsal; ventral fins well developed, inserted in advance of pectorals; pectorals rather large, about as long as head.

Color in alcohol brownish, some specimens darker than others (this difference in color apparently bearing no relationship to sex); sides and head with dark spots, these largest on lower part of sides and smallest dorsally on head; some individuals less profusely spotted but with indefinite cross bars extending on dorsal fin; chin nearly always with two and occasionally with three dark bars; ventral fins nearly black; the other fins paler than the body, variously spotted; the caudal usually cross-banded; anal fin with the free tips of rays pale.

This blenny is represented in the present collection by 15 specimens, ranging in length from 43 to 93 millimeters ($1\frac{3}{4}$ to $3\frac{3}{4}$ inches). This species is readily distinguished from other blennies of Chesapeake Bay by the very steep, almost vertical forehead, and by the deeply concave interorbital. The branched tentacle over the eye also helps to identify it.

The food of this blenny, as shown by the contents of five stomachs, consists of small crustaceans, mollusks, and ascidians. The comparatively large quantity of plant fragments present suggests that it may also feed on vegetable matter.

Ripe or nearly ripe fish were taken in May, July, and September, indicating that spawning may take place throughout the summer.

The maximum length given for this fish in published accounts is 4 inches, which slightly exceeds the length of the largest specimen at hand. It was infrequently taken in nets in shallow water, the latest date along shore being November 23, at Cape Charles, and somewhat more frequently during the winter with the beam trawl operated from the *Fish Hawk* in water ranging from 13 to 25 fathoms in depth. This blenny may not be as rare as indicated by the collection, for it may live, like some of the other blennies, where it is inaccessible to nets.

Habitat.—Chesapeake Bay to Florida.

Chesapeake localities.—(a) Previous records: Cape Charles city, Old Point Comfort, and Ocean View, Va. (b) Specimens in collection: From off Bloody Point, off Cove Point, off Barren Island, off Cedar Point, off Hooper Island, off Point No Point, and Crisfield, Md., and off Smith Point, Cape Charles, lower York River, off Old Point Comfort, Ocean View, and Lynnhaven Roads, Va.

146. Genus *BLENNIUS* Linnæus. Blennies

Body oblong, compressed; head short, its upper profile usually bluntly rounded; mouth small, horizontal; teeth in a single series in each jaw, long and slender, curved inward; lower jaw in addition with a stout fanglike tooth on each side; premaxillaries not protractile; gill openings wide, the membranes free from the isthmus, or at least forming a broad fold across it; scales wanting; dorsal fin entire or more or less notched, the spines slender; ventrals well developed, I, 3 rays; pectorals moderately developed.

187. *Blennius fucorum* Cuvier and Valenciennes. Seaweed blenny.

Blennius fucorum Cuvier and Valenciennes, Hist. Nat. Poiss., XI, 1836, p. 263; open seas south of the Azores. Uhler and Lugger, 1876, ed. I, p. 97; ed. II, p. 81; Jordan and Evermann, 1896-1900, p. 2379.

This blenny was recorded from Chesapeake Bay by Uhler and Lugger (1876), whose description we quote in full. It has not been seen there by other investigators.

"Body small, cylindrical, and scaleless; head large, deeper than long; the large and very prominent eyes project beyond the face; a thread-shaped cirrus, bifid at tip, and nearly as long as the head, projects from the upper part of each orbit. Soiled greenish, brownish above, with numerous brown spots on the cheeks and sides of the body; throat and belly faintly rosaceous. Length, 1 to 2 inches. Fin rays, D. 11, 17; P. 14; V. 3; A. 18; C. 14."

It is rather remarkable that this blenny, usually found among seaweed in the open seas, should have been taken well up Chesapeake Bay.

Habitat.—Atlantic Ocean, in floating seaweed, and from Chesapeake Bay.

Chesapeake localities.—(a) Previous record: Oyster region south of Tangier Sound (Uhler and Lugger, 1876). (b) Specimens in collection: None.

Family LXXXIV.—OPHIDIIDÆ. The cusk eels

Body elongate, compressed, more or less eel-shaped; head large; lower jaw included; both jaws and usually vomer and palatines with villiform or blunt teeth; premaxillaries protractile; gill openings wide, the membranes separate, anteriorly narrowly joined to the isthmus behind ventrals; pseudobranchiæ small; gills 4, a slit behind the fourth; scales small, covering body and occasionally the head; air bladder and pyloric cæca present; vertical fins low, without spines, confluent around the tail; tail isocercal; ventral fins at the throat, each developed as a long, forked barbel. A single genus and species comes within the scope of the present work.

147. Genus *RISSOLA* Jordan and Evermann. Cusk eels

Body moderately elongate; lower jaws included; teeth in jaw pointed, those on vomer and palatines blunt; vent posterior, at origin of anal; no spines on opercles; scales present on body, wanting on head, elongate in shape and somewhat imbedded; air bladder placed just back of the cranium, very short, described as having a foramen posteriorly. This, however, appears to be a mistake, for the posterior end of the bladder really is closed by a small, solid, conical, nearly transparent body connected with the wall of the bladder by a very thin membrane. Two fresh specimens

examined by us had this body in position as explained; a third alcoholic specimen had the little solid body pushed into the cavity of the bladder and this gave the bladder the appearance of having a foramen.

188. *Rissola marginata* (DeKay). Cusk eel.

Ophidium marginatum DeKay, New York Fauna, Fishes, 1842, 315; New York Harbor. Bean, 1891, p. 85.

Rissola marginata Jordan and Evermann, 1896-1900, p. 2489, Pl. CCCLIII, fig. 868.

Head 5.95 to 6.15; depth 7.3 to 8.2. Body quite elongate, compressed, of about uniform depth from nape to middle of anal base, then tapering to tail; head compressed; snout moderately pointed, 3.5 to 4.05 in head; eye 3.05 to 3.3; interorbital (bone) 4.75 to 6.85; mouth moderately large, horizontal; lower jaw included; maxillary reaching nearly or quite to posterior margin of eye, 2 to 2.15 in head; teeth in jaws pointed, in bands; vomer and palatines with bands of blunt teeth; gill rakers short, four to five on lower limb of first arch; lateral line usually not quite complete; scales small, elongate, imbedded, wanting on head; dorsal and anal fins long, low, continuous with the round caudal; origin of dorsal over or a little behind middle of length of pectorals; origin of anal a little behind the beginning of the second one-third of body; ventral fins inserted below vertical from middle of eye, consisting of two filaments, the longest one about an eye's diameter shorter than head; pectoral fins moderately large, 1.2 to 1.3 in head.

Color in life grayish green; sides golden; belly snow white; ventral surface of head mostly golden; sides of head punctulated with brown; lateral line in a dark band; dorsal fin pale green with black margin, this color continued on caudal and posterior half of anal fin; margin on anterior half of anal white; ventrals white; pectorals golden with distal and lower margins white. The color in alcohol fades to a light brown; the fins pale, with margins as in the live fish.

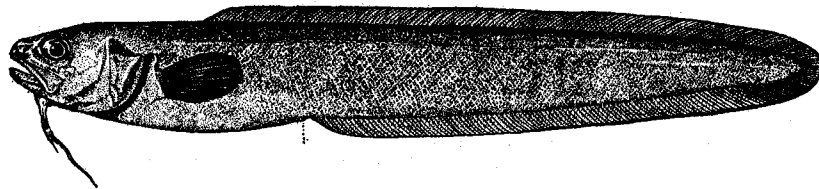


FIG. 202.—*Rissola marginata*. Adult, 8¼ inches long

The cusk eel is represented in the present collection by five specimens, ranging in length from 145 to 230 millimeters (5¾ to 9 inches) in length. This fish is readily distinguished from all others of Chesapeake Bay by its long, somewhat eel-like body and by the white, filamentous ventral fins (each fin with two slender filaments) situated behind the chin and below the eyes.

Little is known about the life history of this fish. It appears to be nocturnal in its habits. An individual kept in the aquarium by one of us (Hildebrand), in the laboratory at Beaufort, N. C., remained concealed during the day in the sand placed in the aquarium. Frequently only a current of water could be seen where its snout was near the surface. At night, however, it frequently was seen swimming about in the aquarium, presumably searching for food. Its tail is supported by heavy cartilage radiating from the last vertebra and is used in burrowing in the sand, for it always descends into the sand with the tail down.

Three examples were examined for food. All had fed on small crustaceans and one had also eaten a small fish—a goby. The ovary is single, showing a median fold, however. It is not known when spawning takes place. Three specimens examined were females, one taken on May 21, another on July 16, and the third on September 12; the ovaries of all appeared to be in an early stage of development.

It is difficult to know, of course, how common a species like the present one (which apparently remains burrowed in the sand throughout the day) really is, without doing considerable collecting at night. Two of the specimens at hand were taken along a sandy beach with a seine at 3 o'clock in the morning, another was found dead on the beach, and two more were taken by the *Fish Hawk* in a beam trawl at a depth of 10 fathoms. It is not known to the writers whether this haul by

the *Fish Hawk* was made during the day or at night. The cusk eel, however, is not known to be abundant anywhere, and it probably is rather uncommon in Chesapeake Bay.

Habitat.—New York to Texas; along sandy shores.

Chesapeake localities.—(a) Previous record: Cape Charles city, Va. (b) Specimens in collection: Cape Charles, off Cape Charles Light, and Lynnhaven Roads, Va.

Family LXXXV.—BATRACHOIDIDÆ. The toadfishes

Body robust, depressed anteriorly, compressed posteriorly; mouth large; teeth strong; gill openings chiefly lateral, the membranes united to the isthmus; scales present or wanting; air bladder present; dorsal fins 2, the first with two or three low spines; second dorsal and anal long, similar; caudal fin round and free from the dorsal and anal; ventral fins large, jugular; pectoral fins broad. A single genus and species comes within the scope of the present work.

148. Genus OPSANUS Rafinesque. Toadfishes

Body robust, notably depressed anteriorly, compressed posteriorly; head large, with numerous fleshy flaps; mouth very broad; teeth very strong, blunt, mostly in a single series, present on jaws, vomer, and palatines; opercle with two partly concealed spines; skin scaleless, wrinkled; lateral line obscure; three dorsal spines; axil of pectoral with a large foramen.

189. *Opsanus tau* (Linnæus). Toadfish.

Gadus tau Linnæus, Syst. Nat., ed. XII, 1766, p. 440; Carolina.

Batrachus tau Uhler and Lugger, 1876, ed. I, p. 98; ed. II, p. 82; Bean, 1891, p. 86; Smith, 1892, p. 72.

Opsanus tau Jordan and Evermann, 1896-1900, p. 2315; Smith and Bean, 1899, p. 187; Evermann and Hildebrand, 1910, p. 163; Fowler, 1912, p. 59.

Head 2.65 to 3.05; depth 3.55 to 4.7; D. III-26 or 27; A. 21 or 22. Body robust, anteriorly very broad, depressed (especially in adult), posteriorly compressed; head very large and broad; snout short and broad, 3.9 to 5 in head; eye 3.45 to 4.95; interorbital (bone) 6.55 to 12.85; mouth large and broad; lower jaw projecting; maxillary reaching well beyond eye, 1.55 to 2.15 in head; teeth strong, blunt, in a single series laterally in the jaws, anteriorly forming more or less of a band; a row of somewhat stronger teeth on vomer and palatines; opercle with three strong spines; skin smooth; barbels or tentacles present on head, about the mouth, and sometimes on sides of body; these enlarged over the eyes and on lower jaw; first dorsal with three short spines, enveloped in skin; second dorsal long and of about uniform height; caudal fin round; anal fin long, the rays distally more or less free; ventral fins rather small, the anterior rays enveloped in heavy skin; pectoral fins broad, fan-shaped, 1.4 to 1.65 in head.

Color in alcohol variable, grayish to brownish above, pale underneath, with profuse markings of darker and lighter color on the sides; fins all with dark and pale bars. Several adult toadfish observed in an aquarium at Woods Hole, Mass., were yellowish brown, mottled with darker brown on body and fins. The dark markings on dorsal and anal were in the form of irregular, oblique bars, and on the caudal in transverse bars. The outer half of pectorals was marked with concentric bars, the basal part being mottled like the body. This color pattern is typical (at least, of all those that we have seen from various localities between Maine and Florida) of the toadfish throughout its range.

Numerous specimens, ranging in length from 30 to 320 millimeters ($1\frac{1}{8}$ to $12\frac{5}{8}$ inches), were preserved. Its scaleless skin, broad head with numerous fleshy fringes, its long, soft dorsal fin, and its fleshy ventral fins, placed under the throat, serve well to distinguish this fish from all others occurring in Chesapeake Bay.

The toadfish is omnivorous. The principal food, however, appears to consist of crustaceans. Among a lot of 31 individuals, 25 had either fed on crustaceans, in combination with mollusks, or on fish. Small crabs among the crustaceans appeared most frequently in the food, although shrimp (and in the smaller individuals, amphipods) and isopods also were present. Almost any kind of offal is eaten, and in places where garbage is thrown overboard toadfish are almost always present in comparatively large numbers.

In Chesapeake Bay spawning apparently takes place throughout the summer, as females with large eggs were taken from April 13 to October 25, 1922. The eggs are very large, being about 5 millimeters in diameter, and are laid under stones, in large shells, tin cans, old shoes, boiler tubes, etc. They adhere in a single layer to the surface upon which they are deposited. The nest is guarded by the male during the period of incubation, which is reported to cover a period of about three weeks. (For a comprehensive account of the spawning habits of the toadfish, see Gudger, 1910, pp. 1095 to 1106.) The larval toadfish remains attached to the yolk sac and the "nest" for several days after it breaks the egg case. When it finally becomes a free-swimming fish it is about 15 or 16 millimeters in length.

Owing to the protracted spawning season, it was difficult to follow the growth of the young in Chesapeake Bay. The smallest specimen, 30 millimeters ($1\frac{1}{8}$ inches) long, was caught on July 8 along with 15 fish ranging up to 137 millimeters ($5\frac{3}{8}$ inches); the larger fish obviously belonged to a different year group. A fish 63 millimeters ($2\frac{1}{2}$ inches) long, taken on June 23, may have been hatched the previous fall. Small fish were seined throughout the summer. A specimen 48 millimeters long, taken on April 20, and one 57 millimeters (2 to $2\frac{1}{4}$ inches) in length, taken April 26, undoubtedly were hatched the previous year, probably in the late summer or fall.

The toadfish is sluggish in its habits. It is very ugly in appearance, always being densely coated with slime. It often makes a croaking sound when removed from the water, and it erects its spines and snaps with its mouth at anything that comes near. Its sharp spines on the opercle

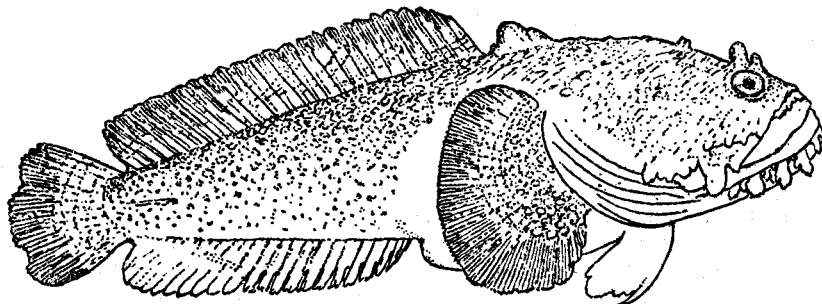


FIG. 203.—*Opsanus tau*

and in the dorsal fin, and its large mouth, provided with strong teeth and powerful jaws, are weapons to be feared, for with these it can inflict painful wounds. It is very tenacious of life, living for a comparatively long period of time out of water.

The maximum size attained by this fish, as given in published accounts, is 15 inches. Such a size, however, must be regarded as exceptional, as apparently few exceed a length of 12 inches. The largest individual seen in Chesapeake Bay during the present investigation was $12\frac{5}{8}$ inches in length and weighed 1 pound 2 ounces. The toadfish is comparatively abundant in Chesapeake Bay and is taken throughout the summer in seines, with hooks and lines, and rather rarely in pound nets. It was taken by the *Fish Hawk* with the beam trawl, during the winter months, in water ranging from 5 to 27 fathoms in depth. This fish is much disliked by the fishermen because of its ugliness and its fighting habits and because it has no commercial value. The flesh is said to be of good appearance and fine flavor, but the fish apparently is not utilized on account of its repulsive appearance. Possibly a demand could be created if the fish were dressed by removing the head, skin, and internal organs before placing it on the market, as is sometimes done with the catfishes.

Habitat.—Maine to the West Indies; rare north of Cape Cod.

Chesapeake localities.—(a) Previous records: "Lives in the mud of the oyster regions of Chesapeake Bay, around the mouth of the Potomac River, and elsewhere in salt water" (Uhler and Lugger, 1876); Gunston Wharf, Cape Charles city, and Hampton Roads, Va. (b) Specimens in the collection: From many localities from Annapolis, Md., to the entrance of the bay.

Order XENOPTERYGII

Family LXXXVI.—GOBIESOCIDÆ. The clingfishes

Body rather elongate, broad, and depressed anteriorly; mouth moderate; upper jaw protractile; teeth usually rather strong, the anterior ones conical or incisorlike; no bony stay across cheek; opercle reduced to a spinelike projection, concealed in the skin and sometimes obsolete; pseudobranchiæ small or wanting; gills $2\frac{1}{2}$ or 3; gill membranes broadly united, free, or united with the isthmus; scales entirely wanting; dorsal and anal similar, on posterior part of body and nearly or quite opposite each other, consisting of soft rays only; ventral fins far apart, each with one concealed spine and four or five soft rays; a large sucking disk present between the ventrals, the fins usually forming a part of it. This family is composed of small fishes that live chiefly in warm seas, clinging to stones and other objects by means of the sucking disk.

149. Genus GOBIESOX Lacépède. Clingfishes

Body anteriorly very broad and depressed, posteriorly slender; head large, rounded; mouth terminal; lower jaw with a series of strong incisors in front, their edges rounded or truncate; upper jaw with a series of strong teeth, sometimes with smaller teeth behind; no teeth on vomer or palatines; gills 3; gill membranes broadly united, free from the isthmus; sucking disk large.

190. *Gobiesox strumosus* Cope. Clingfish.

Gobiesox strumosus Cope, Proc., Ac. Nat. Sci., Phila., 1870, p. 121; Hilton Head, S. C. Uhler and Lugger, 1876, ed. II, p. 84; Jordan and Evermann, 1896-1900, p. 2333; Evermann and Hildebrand, 1910, p. 163.
Gobiesox virgatulus Jordan and Evermann, 1896-1900, p. 2333.

Head 2.45 to 2.7; depth 4.1 to 5; D. 10 to 12; A. 8 to 10. Body anteriorly broad, depressed; posteriorly compressed; caudal peduncle strongly compressed; vertebrae 12 to 14; head large, depressed, very broad, quite variable in width, its width 2.5 to 3.35 in length of body; snout very broad, forming with the rest of the head anteriorly an arc of a circle, its length 2.8 to 3.65 in the head; eyes small, partly superior, 3.65 to 4.75; interorbital broad, flat, 3.2 to 3.8; mouth wide, inferior, horizontal; maxillary concealed by the preorbital, reaching nearly or quite opposite middle of eye, 6 to 7.7 in head; teeth in the jaws with an irregular, enlarged outer series, these teeth anteriorly in the lower jaw incisorlike, the cutting edge entire, those of the upper jaw less strongly compressed and less incisorlike; both jaws anteriorly with smaller teeth behind the enlarged ones; cheeks full, bulging; opercle ending in a sharp spine; gill opening restricted, mostly lateral; dorsal fin placed far back, its origin nearer the end of the caudal than tip of snout; caudal fin round; anal fin shorter but otherwise similar to the dorsal, its origin a little nearer tip of caudal than anterior margin of ventral disk; ventral disk a little shorter than head.

Color in alcohol grayish to dusky, variable, some specimens much lighter than others; some specimens with distinct pale crossbars, others with indefinite blotches, still others without indications of pale bars or blotches, but with longitudinally elongate dark markings; the vertical fins usually dusky, with pale crossbars or blotches; the ventrals and pectorals pale.

Numerous specimens of this species, ranging in length from 19 to 60 millimeters ($\frac{3}{4}$ to $2\frac{3}{8}$ inches), were preserved. Much variation among individuals with respect to the width of the head and color appears to exist. These differences have been pointed out in the description. This fish is readily distinguished from all others of the Chesapeake by the very broad, depressed head and the large sucking disk between and behind the widely separated ventral fins. The species of this genus are not well defined, making identification difficult. It seems probable that some of the nominal species are not actually distinct. The chief diagnostic characters given in current works are the number of dorsal and anal rays. In the specimens at hand, which undoubtedly are all of one species, the range in the number of fin rays covers the nominal species, *G. strumosus* and *G. virgatulus*. In a lot of 30 specimens the rays in the dorsal fin varied from 10 to 13; that is, 4 had 10 rays, 16 had 11 rays, 9 had 12 rays, and 1 had 13 rays. In the same lot the number of anal rays varied from 8 to 10, as follows: 12 had 8 rays, 15 had 9 rays, and 3 had 10 rays.

We provisionally use the name *strumosus* for the specimens in hand, as it has priority over *virgatulus*. The true relationship of the species will necessarily remain in doubt until a more thorough study of the genus can be made.

The food of this little fish, as shown by the contents of 26 stomachs, consists mainly of isopods and amphipods and an occasional annelid.

Spawning evidently takes place in the spring, as most of the specimens taken in April and May contained well-developed gonads. Those taken later in the season appeared to be spent. The smallest ripe female seen was only $1\frac{3}{8}$ inches in length.

It is difficult to determine the rate of growth of this fish because of the small size attained and because of the gradation of all sizes taken throughout the spring, summer, and fall. The smallest fish secured, a specimen 19 millimeters (four-fifths inch) in length, was taken on October 10.

The maximum size of *G. virgatulus*, which is herein considered identical with *strumosus*, as given by Jordan and Evermann (1896-1900, p. 2333), is 4 inches. It seems doubtful that the clingfish ever grows that large in Chesapeake Bay, as the largest of hundreds taken during the present investigation was only $2\frac{3}{8}$ inches in length. This small fish, although previously only twice recorded from the Chesapeake, is quite common. It was rather scarce from Buckroe Beach to Cape Henry and at Cape Charles, but common to abundant from the York River to Annapolis. It was found in large numbers in the lower Rappahannock and Patuxent Rivers, where it was taken in company with pipefishes and sticklebacks on grassy bottom in 1 to 3 feet of water. Although rather common at Annapolis, none were seined along the shores at Love Point. One specimen, however, was trawled off Love Point on May 13 in 110 feet of water; none were found in the vicinity of Baltimore or Havre de Grace.

The clingfish, by means of its large sucking disk, is able to attach itself to shells, rocks, piling, etc., and it is not infrequently found adhering to such objects. For this reason it is sometimes not taken in nets in localities where it is comparatively common. A few individuals were taken by the *Fish Hawk* during the winter months in water ranging in depth from 7 to 17 fathoms.

Habitat.—Chesapeake Bay; probably to Florida or beyond.

Chesapeake localities.—(a) Previous records: Magothy River and St. Georges Island, Md. (b) Specimens in collection: From many localities between Annapolis, Md., and the mouth of the bay.

Order PLECTOGNATHI

Family LXXXVII.—BALISTIDÆ. The trigger fishes

Body usually rather deep, considerably compressed; snout long; eye small, placed high; mouth small, usually terminal; teeth in the jaws in a single series, frequently incisorlike; gill openings represented by oblique slits; preopercular bones externally not evident; scales more or less platelike, bearing spines or bony tubercles; dorsal fins 2, the first spine high and strong; ventral fins represented by a single stout spine attached to the enlarged pubic bone. A single genus of this family of tropical fishes comes within the scope of the present work.

150. Genus BALISTES Linnæus. Trigger fishes

Body compressed, rather deep; snout long; eye small, placed very high; mouth small, terminal; gill opening an oblique slit with enlarged bony scutes behind it; teeth in the jaws irregular, usually very strong; scales platelike, usually bearing spinules; first dorsal with three spines, the first one much enlarged, erect and fixed when the second one is erect, readily laid back upon deflexing the second spine, hence the name "trigger fishes"; second dorsal and anal long, usually similar; ventrals represented by a single median spine. A single species has been taken in Chesapeake Bay. A second one is recorded from both north and south of the bay and may be expected within the bay. Accordingly, the following key, showing the chief differences of the two, is introduced:

KEY TO THE SPECIES

- a. Head without prominent bands or stripes; outer caudal rays never greatly produced; D. III-27 to 29; A. 23 to 26; scales 54 to 62----- *carolinensis*, p. 341
 aa. Head with prominent dark blue stripes and bars on side; outer rays of caudal greatly produced in adult, filamentous; D. III-29 or 30; A. 26 to 28; scales 60 to 62----- *vetula*, p. 341

191. *Balistes carolinensis* Gmelin. Trigger fish; Leatherjacket; Turbot.

Balistes carolinensis Gmelin, Sys. Nat. I, 1788, p. 1468; Carolina. Jordan and Evermann, 1896-1900, p. 1701, Pl. CCLVIII, fig. 632.

Head 3; depth 1.8; D. III-27; A. 25; scales (counted from gill opening to base of caudal) 58. Body deep, rather strongly compressed; dorsal and ventral outlines about evenly convex; head deep; snout long, tapering, 1.32 in head; eye small, 4.4; interorbital 3.15; mouth small, terminal; teeth in jaws large and strong, the anterior ones more or less caninelike; gill opening reduced to an oblique slit; lateral line feebly developed, most distinct posteriorly; scales of moderate size, implanted in a thick leathery skin, the edges of scales not free, each scale covered with bony barbs; dorsal fins separate, the first consisting of three short, strong spines, the first one the longest, 1.45

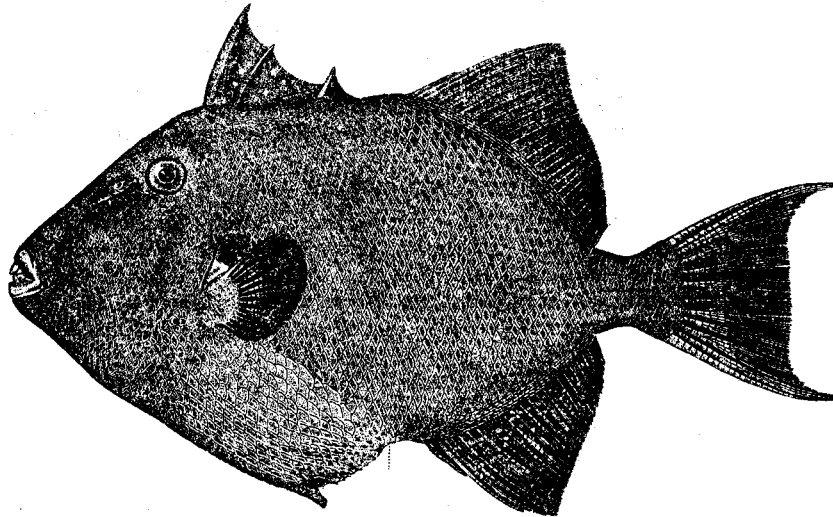


FIG. 204.—*Balistes carolinensis*. Adult, 12½ inches long

in head; second dorsal and anal similar, highest anteriorly; caudal fin with concave margin; ventral fins represented by a single blunt spine, thickly covered with coarse barbs; pectoral fins short, round, 2.55 in head.

Color in alcohol grayish green; interorbital area blackish; indications of a blackish bar under base of spinous dorsal, extending to pectoral; another and more distinct one at origin of second dorsal; two dark blotches under base of second dorsal; another on caudal peduncle; fins more or less greenish to dusky; spinous dorsal with pale spots on membranes; caudal fin plain; all other fins with dark spots, streaks, or bars.

A single specimen, 250 millimeters (9¾ inches) in length is at hand and upon it the foregoing description is based. The trigger fish is recognized by the deep, compressed body; small eye, which is placed very high; small mouth, with large teeth; short gill opening; protruding pubic bone; and the very large first dorsal spine. The chief differences between this fish and its near West Indian relative, *B. vetula*, which to date has not been taken in Chesapeake Bay but which is not infrequently found at Woods Hole, are set forth in the accompanying key.

Nothing definite seems to be known about the food and feeding habits of the trigger fish. It is taken occasionally on the blackfish grounds off Beaufort, N. C., with hook and line, baited

with pieces of fish; and at Key West, Fla., where it is known as "turbot," it is similarly taken in company with grunts.

Its spawning habits and rate of growth, too, are not known. R. L. Barney (field notes) took a female on the sea beach of Bogue Banks, Beaufort, N. C., on July 1, 1920, which contained "very ripe" spawn. The trigger fish is reported to reach a weight of 4 pounds, but the average is about 1 pound.

This fish evidently is rare in Chesapeake Bay, for it was not seen by the field men during the present investigation, and we have not seen a record or heard of its previous capture within the bay. The specimen at hand was caught with hook and line at the mouth of the Potomac River on September 21, 1922, by D. E. Knight, who presented the specimen to the Bureau of Fisheries.

Habitat.—Both coasts of the tropical Atlantic; on the American coast from Nova Scotia to the Dutch West Indies (St. Eustatius, Windward Islands); not common north of Florida.

Chesapeake records.—(a) Previous records: None. (b) Specimen in collection: From the mouth of the Potomac River, Md.

Family LXXXVIII.—MONACANTHIDÆ. The filefishes

Body much compressed, usually quite deep; mouth small, terminal or more or less superior; jaws with incisorlike teeth; those of the upper jaw in a double series, in a single series in lower jaw; gill openings mere slits; lateral line absent; scales small, bearing spines; first dorsal consisting of a single spine (rarely with a second rudimentary spine), smooth or barbed; second dorsal remote from the first and similar to the anal; ventrals either absent or represented by a long spine surmounting the pelvic bone. Two genera and two species of this family of warm-water fishes occur in Chesapeake Bay.

KEY TO THE GENERA

- a. Dorsal spine long and comparatively strong, with two rows of retrorse hooks or barbs posteriorly; pelvic bones surmounted by a spine projecting through the skin of the abdomen; gill slit short, not longer than eye..... *Monacanthus*, p. 342
- aa. Dorsal spine rather weak and comparatively short, without barbs; pelvic bones without a spine; gill slits notably longer than eye..... *Ceratacanthus*, p. 343

151. Genus MONACANTHUS (Cuvier) Oken. Foolfishes; Filefishes

Body short and deep, much compressed; mouth very small, terminal; gill slit oblique, shorter than eye; ventral flap and sometimes caudal peduncle spinous; dorsal spine large, posteriorly with two series of barbs; second dorsal remote from the spine and similar to the anal, each consisting of 25 or more rays; caudal fin broad, round; pectoral fins short and broad; a blunt, movable pelvic spine present. A single species comes within the scope of the present work.

192. *Monacanthus hispidus* (Linnæus). Foolfish; Filefish.

Ballistes hispidus Linnæus, Syst. Nat., ed. XII, 1766, p. 405; Carolina.

Stephanolepis massachusettensis Uhler and Lugger, 1876, ed. I, p. 90; ed. II, p. 75.

Monacanthus hispidus Bean, 1891, p. 84; Jordan and Evermann, 1896-1900, p. 1715, Pl. CCLIX, fig. 635; Evermann and Hilbrand, 1910, p. 162.

Head 2.7 to 3.1 (measured to upper angle of gill opening); depth 1.5 to 1.65; D. I-32 to 34; A. 31 to 34. Body short and deep, strongly compressed; profile from snout to dorsal slightly concave; snout long, 1.4 to 1.75 in head; eye 2.2 to 3.2; interorbital 3.15 to 3.5; mouth very small, terminal; teeth in the jaws broad, with sharp cutting edges; gill opening an oblique slit, situated between the eye and the base of dorsal; scales minute, beset with short, rough bristles; first dorsal consisting of a single barbed spine inserted over posterior part of eye, remote from second dorsal; second dorsal and anal similar and opposite each other, first ray of dorsal sometimes filamentous; caudal fin with convex margin; ventral fins represented by a single median spine, extending beyond flap of skin attaching the spine to the abdomen; pectoral fins short, 1.95 to 2.2 in head.

Color variable, grayish or greenish; sides with irregular blackish blotches or with more or less definitely horizontally elongated black spots; caudal fin often dusky; other fins plain translucent.

This foolfish is represented in the present collection by 110 specimens, ranging from 31 to 80 millimeters in length. This fish is recognized by the short, deep body, rough skin, the prominent, barbed dorsal spine, and the rough ventral spine.

Numerous specimens examined at Beaufort, N. C., by Linton (1905, p. 401) had fed on bryozoans, small crustaceans and mollusks, gastropod eggs, annelids, small sea urchins, and algæ. Seven specimens examined from Chesapeake Bay, ranging in length from 60 to 80 millimeters, had fed mainly on annelids. One specimen contained fragments of shells of a mollusk, and three contained vegetable fragments.

Nothing is known concerning the spawning and breeding habits of this fish, and so far as we are aware no fish with gonads in an advanced state of development has been observed.

The foolfish reaches a maximum length of 10 inches. It is not eaten and has no commercial value.

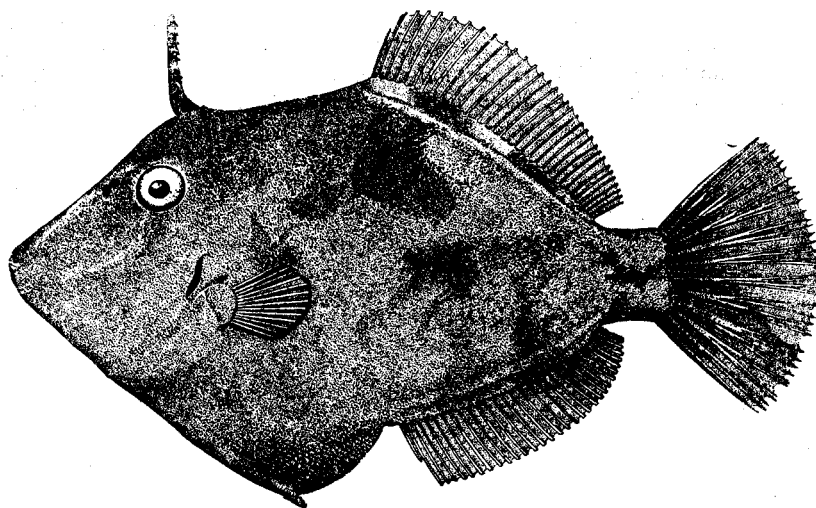


FIG. 205.—*Monacanthus hispidus*

Habitat.—Nova Scotia, south to Brazil; also recorded from the Canaries and Maderia in the eastern Atlantic. It is uncommon on the American coast north of Woods Hole, Mass., and it apparently does not occur regularly within Chesapeake Bay.

Chesapeake localities.—(a) Previous records: Cape Charles city and Ocean View, Va. (b) Specimens in collection: Cape Charles, Va., 110 specimens, all taken on September 23, 1921, in 6 hauls of a 250-foot bag seine. The species was not seen during other visits to Cape Charles, nor was it seen elsewhere in Chesapeake Bay during the present investigation.

152. Genus *CERATACANTHUS* Gill. Foolfishes; Filefishes

Body elongate, strongly compressed; mouth more or less superior; lower jaw projecting; gill opening consisting of a very oblique slit, much longer than eye; first dorsal consisting of a single, barbed spine; second dorsal remote from the first, its rays about 35 to 50; anal fin similar to soft dorsal; caudal fin more or less elongate, round, or somewhat pointed; pectoral fins very small; no external pelvic spine. A single species of this genus of warm-water fishes comes within the scope of the present work.

193. *Ceratacanthus schœpfi* (Walbaum). Filefish; Foolfish; Devilfish.

Balistes schœpfi Walbaum, Art. Gen. Pisc., 1792, p. 461; Long Island, N. Y.

Alutera cuspidata Uhler and Lugger, 1876, ed. I, p. 89; ed. II, p. 74.

Ceratacanthus aurantiacus Lugger, 1877, p. 61.

Alutera schœpfi Bean, 1891, p. 84; Jordan and Evermann, 1898, p. 1718, Pl. COLX, fig. 636; Fowler, 1912, p. 59.

Head 3.3 to 3.7 (measured to upper angle of gill opening); depth 1.95 to 2.65; D. I-34 to 37; A. 36 to 41. Body elongate, very strongly compressed, proportionately deeper in adult than in young; profile from snout to dorsal spine nearly straight to notably concave in small to moderate-sized specimens, concave over snout and convex over eyes in large individuals, measuring upward of 400 millimeters in length; snout long, 1.1 to 1.2 in head; eye 3.8 to 5.4; interorbital 3.9 to 5.2; mouth very small, superior, nearly vertical; teeth in the jaws broad, those of the lower jaw usually deeply notched, all with sharp cutting edges; gill opening consisting of an oblique slit, situated partly between the eye and base of pectoral; scales minute, not very evident in young, rough, being covered with short spines; first dorsal consisting of a single, rough, barbless spine situated over eye, remote from the second dorsal; second dorsal and anal similar and opposite each other; caudal fin long in small individuals, about half the length of body in specimens 145 millimeters long, shorter than snout in large examples (400 millimeters and upward); pectoral fins short, 2.45 to 3.1 in head.

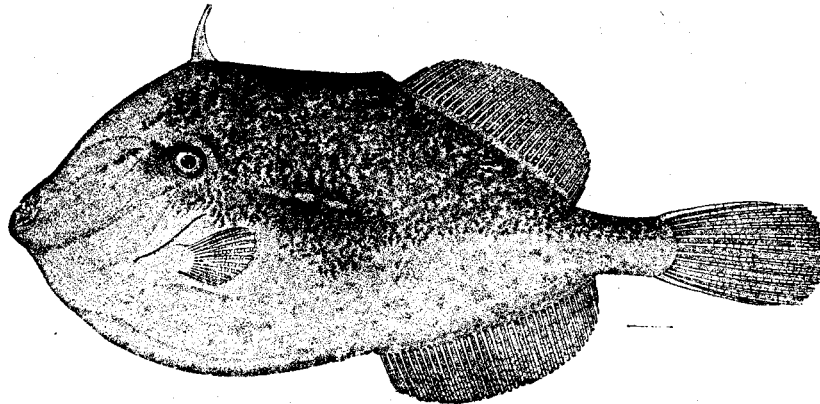


FIG. 206.—*Ceratacanthus schœpfi*

Color variable; specimens 6 to 8 inches long largely black or grayish; irregular dusky blotches, chiefly near bases of dorsal and anal fins; sides with well-defined, small, round, dusky or brownish spots, spaced irregularly, often forming a straight line along middle of sides, beginning below origin of soft dorsal and extending to base of caudal; nape plain or dusky; dorsal plain, tinged with yellow brown; caudal black, light brown at base; anal plain, outer edge tinged with brown; pectoral plain. A fish 18 inches in length was brownish on back and sides, spotted with yellow and orange; lower parts yellow and white; dorsal and anal dusky; caudal grayish, yellow at base; pectorals plain. Adult fish vary considerably in color pattern, the usual colors being brown, gray, yellow, orange, and white.

This fish is represented in the present collection by 13 specimens, ranging in length from 145 to 460 millimeters ($5\frac{3}{4}$ to 18 inches). This foolfish differs from its relative, *M. hispidus*, principally in the more elongate body, a proportionately shorter dorsal spine, which has no barbs, and in the absence of a ventral spine. It also attains a much larger size. The young differ prominently from the adults in having the body much more slender and in having a proportionately much longer caudal fin.

Small examples examined by Linton (1905, p. 401) had fed on bryozoans, shrimp, amphipods, and sea lettuce. A specimen 460 millimeters long, from Chesapeake Bay, had fed exclusively on an unidentified plant resembling *Naias*. This plant filled the whole alimentary tract, which is of about uniform diameter throughout and about three times the total length of the fish.

Virtually nothing is known about the spawning and breeding habits of this fish. A large specimen taken in Lynnhaven Roads on May 17, 1921, had the ovaries somewhat developed, and they contained numerous eggs just distinguishable with the unaided eye. Eight fish caught at Ocean View, Va., on October 4 to 22, 1922, were 151 to 227 millimeters (6 to 9 inches) in length.

This foolfish is reported to attain a length of 2 feet. Although common within most of its range, it is not taken in large numbers and has no commercial value. It is called foolfish probably in part because of its awkward appearance and actions, and also because of its stupidity in escaping from a net. It often remains in a net when avenues for escape are plainly evident and when all other fish have left it. When removed from a net and placed in open water it usually remains quiet for some time before apparently knowing that it can swim away at will. Its rough skin, no doubt, has given rise to the name "filefish."

Habitat.—Portland, Me., to Brazil; uncommon north of Cape Cod.

Chesapeake localities.—(a) Previous records: St. Marys River, Md.; "southern part of Chesapeake Bay" (Lugger, 1877); Cape Charles and Hampton Roads, Va. (b) Specimens in collection: Cape Charles, Ocean View, and Lynnhaven Roads, Va.

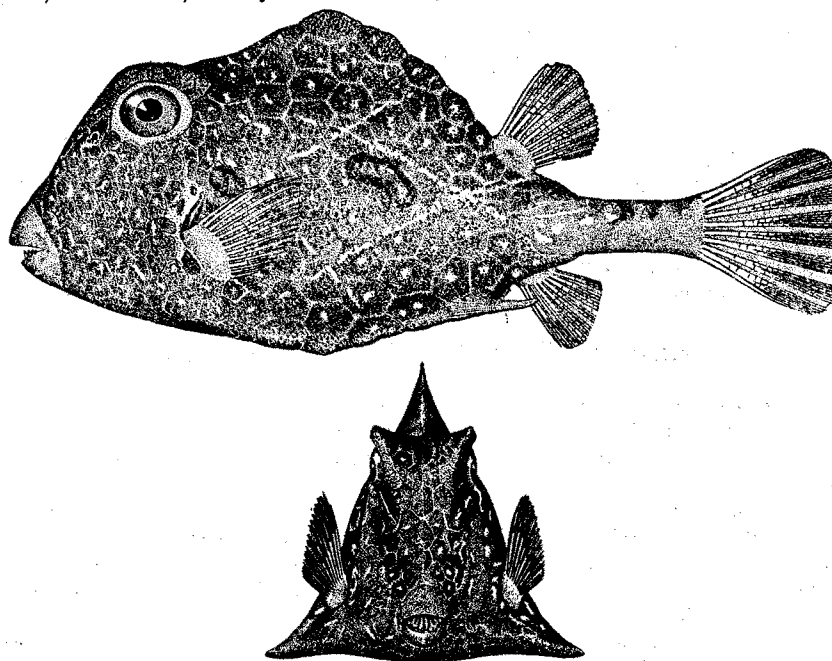


FIG. 207.—*Lactophrys trigonus*

Family LXXXIX.—OSTRACIIDÆ. The trunkfishes

Body short, cuboid, three, four, or five angled, covered by a hard, boxlike shell composed of polygonal plates, these wanting only on caudal peduncle, about the mouth and the bases of the fins; mouth small, terminal; a single row of pointed teeth in each jaw; gill opening consisting of a more or less vertical slit, situated below and posterior to eye; dorsal fin small, composed of soft rays only, placed far backward; caudal fin square or round; anal fin similar to the dorsal and nearly opposite it; ventral fins wanting; pectoral fins short.

153. Genus LACTOPHRYS Swainson. Three-angled trunkfishes .

Body, in adult at least, three angled; ventral surface flat or concave; carapace closed behind anal fin; frontal and lateral spines present or wanting; dorsal fin with 9 or 10 rays. A single species of this genus is known to occur rarely in Chesapeake Bay.

194. *Lactophrys trigonus* (Linnaeus). Trunkfish; Shellfish; Boxfish.

Ostracion trigonus Linnaeus, Syst. Nat., ed. X, 1758, p. 330; "India."

Lactophrys trigonus Uhler and Lugger, ed. I, p. 88; ed. II, p. 74; Jordan and Evermann, 1898, p. 1723, Pl. COLXIII, fig. 641.

A single very small individual, described as follows, is at hand. In this species the young differ greatly from the adult.

Head 2; depth 1.3; D. 9; A. 9. Body more or less four-angled, with a prominent median ridge on back; the carapace open behind dorsal and without spines; head very deep; snout not much in advance of forehead, 3.2 in head; eye 4; interorbital 2.3; mouth very small, terminal; dorsal and anal fins similar; caudal fin round; pectoral fins broad, the upper rays longest, 3.5 in head.

Color in alcohol uniform brownish; fins plain translucent.

A single small specimen 20 millimeters in length was secured. This is the only trunkfish known from Chesapeake Bay, and it is readily recognized by the hard, boxlike shell that covers the body.

The young are very different from the adult. In large individuals the body is sharply three-angled, and the ventral ridge of the shell, somewhat in advance of the vent, bears a large, flat spine. This spine is undeveloped until the fish reaches a length of about 35 millimeters. The body in the adult is more elongate and not as deep, the depth being contained in the length from 2.6 to 2.8 times. The head in the adult is contained 3.8 times in the body.

This fish reaches a maximum length of about 1 foot. Its flesh is of excellent flavor, and at Key West, Fla., and Colon, Panama, at least, it is used as food.

Habitat.—Woods Hole, Mass., south to Bahia, Brazil; apparently uncommon north of Florida. Only the young appear to have been taken north of Florida.

Chesapeake localities.—(a) Previous records: "Occurring very rarely in the salt waters of the southern part of Chesapeake Bay and around the extremity of St. Marys County" (Uhler and Lugger, 1876). (b) Specimen in collection: Cape Charles, Va.; evidently very rare in Chesapeake Bay.

Family XC.—TETRAODONTIDÆ. The swellfishes

Body oblong or elongate, usually about as broad as deep; belly usually capable of great inflation with water or air, or both; mouth small, terminal; teeth in the jaws fused, forming a continuous cutting edge, except for a median suture; gill slits small, situated in front of pectorals; scales present or absent; the skin often bearing prickles; lateral line conspicuous or not; dorsal fin inserted posteriorly, composed of soft rays only; caudal fin various in shape; anal fin similar to the dorsal and usually opposite it; ventral fins wanting; pectoral fins short and broad.

The members of this family mostly inhabit warm shore waters. They are sluggish swimmers but find a measure of protection in their tough and often prickly skin and by greatly increasing their size, through inflation, which also causes the prickles to stand erect and to appear much more prominent than before inflation. Some of the members of the family attain a considerable size, but none are of commercial importance, as their flesh is said to be rank and sometimes poisonous. Two genera and three species are known from Chesapeake Bay.

KEY TO THE GENERA

- a. Body comparatively elongate; dorsal and anal fins rather long, each with 12 to 15 rays; skin largely smooth.....Lagocephalus, p. 347
- aa. Body oblong, plump; dorsal and anal fins smaller, each with six to eight rays; skin largely prickly.....Tetraodon, p. 347

154. Genus *LAGOCEPHALUS* Swainson. Rabbit fishes or Puffers

Large puffers with smooth skin, except on the abdomen, where prickles are present; lower edge of caudal peduncle with a fold; dorsal and anal fins long, each with 12 to 15 rays; caudal fin concave behind. Two American species are known; only one of these comes within the scope of the present work.

195. *Lagocephalus lævigatus* (Linnæus). Puffer; Rabbit fish; Swellfish.

Tetraodon lævigatus Linnæus, Syst. Nat., ed. XII, 1766, p. 416; Charleston, S. C. Uhler and Lugger, 1876, ed. I, p. 87; ed. II, p. 73.

Lagocephalus lævigatus Jordan and Evermann, 1896-1900, p. 1728, Pl. CCLXII, fig. 642.

Head 3 to 3.75; depth about 3 to 4; D. 14; A. 13. Body elongate, somewhat deeper than broad; head rather long; snout conical, its length 1.7 to 2.75 in head; eye 4.15 to 4.8; interorbital 2.05 to 2.75; mouth small, nearly terminal; teeth in continuous plates, with a median suture, more or less beaklike; lateral line present, branched anteriorly; lower edge of body with a longitudinal fold or keel; abdomen with short spines; skin elsewhere smooth; dorsal and anal similar, the origin of dorsal somewhat in advance of that of anal; caudal fin deeply concave; pectoral fins short and broad, 1.55 to 1.95 in head.

Color dark greenish to dusky above; sides bright silvery; white underneath; gill opening black within; dorsal and caudal mostly dusky; anal and pectorals greenish to slightly dusky.

Only two specimens, 185 and 570 millimeters ($7\frac{3}{8}$ and $22\frac{1}{2}$ inches) long, were preserved. Another large individual, 625 millimeters ($24\frac{3}{4}$ inches) in length, was examined in the field. The

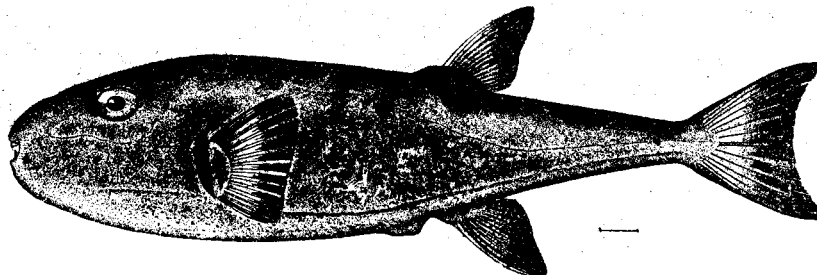


FIG. 208.—*Lagocephalus lævigatus*

foregoing description is based upon these three specimens, the only ones seen in Chesapeake Bay during the present investigation. This puffer is readily distinguished from the others known from the Chesapeake by the smooth, shining skin on the sides, the large dorsal and anal fins, and the concave tail fin.

This is the largest of the American puffers. It reaches a length of fully 2 feet. Its feeding and breeding habits are still virtually unknown. One small specimen, $7\frac{3}{8}$ inches long, was taken on September 26. This puffer is rare in Chesapeake Bay, where it is known as "rabbit fish," because of the rabbitlike eyes. It nowhere has economic value.

Habitat.—Massachusetts to Brazil, uncommon north of Cape Hatteras.

Chesapeake localities.—(a) Previous record: Southern part of Chesapeake Bay (Uhler and Lugger, 1876). (b) Specimens in collection: Lynnhaven Roads, Va., taken in pound nets June 9 and September 26, 1921. Another specimen observed at Ocean View, Va., was taken in a haul seine on October 20, 1922.

155. Genus *TETRAODON* Linnæus. Puffers; Swellfishes

Body oblong, plump, capable of considerable inflation; nasal canal single, with two openings near tip; skin often smooth, sometimes with more or less distinct scalelike dermal development, often also with prickles, at least on back and abdomen, and not infrequently with dermal cirri; dorsal and anal fins similar, small, each consisting of six to eight rays; caudal fin usually straight or convex, rarely slightly concave. Two species of this genus have been recorded from Chesapeake Bay.

KEY TO THE SPECIES

- a. Head rather broad; interorbital 2.2 to 2.85 in head; no white lines or reticulations on back and sides; a lateral series of vertically elongate dark spots.....*maculatus*, p. 348
 aa. Head narrower; interorbital 4.6 to 8 in head; back and sides with white lines, forming reticulations; no definite series of lateral black spots.....*testudineus*, p. 349

196. *Tetraodon maculatus* Bloch and Schneider. Puffer; Swellfish; Swell toad; Balloonfish.

Tetraodon hispidus var. *maculatus* Bloch and Schneider, Syst. Ichth., 1801, p. 504; Long Island, N. Y.

Chilichthys turgidus Uhler and Lugger, 1876, ed. I, p. 88; ed. II, p. 73.

Tetraodon turgidus Bean, 1891, p. 84.

Spherooides maculatus Jordan and Evermann, 1896-1900, p. 1733, Pl. CCLXIV, fig. 645; Evermann and Hildebrand, 1910, p. 162.

Head 2.05 to 2.85; depth about 2 to 3; D. 8; A. 7. Body robust, about as broad as deep; head long; snout conical, 1.7 to 2 in head; eye small, 3.6 to 7.75; interorbital space 2.2 to 2.85; mouth small, terminal; teeth in plates, with a median suture, more or less beaklike; lateral line very feebly developed; no evident fold along lower edge of side; skin everywhere prickly, except on caudal peduncle; dorsal and anal fins similar, the dorsal somewhat in advance of anal; caudal fin with round margin; pectoral fins rather short and broad, 1.95 to 2.35 in head.

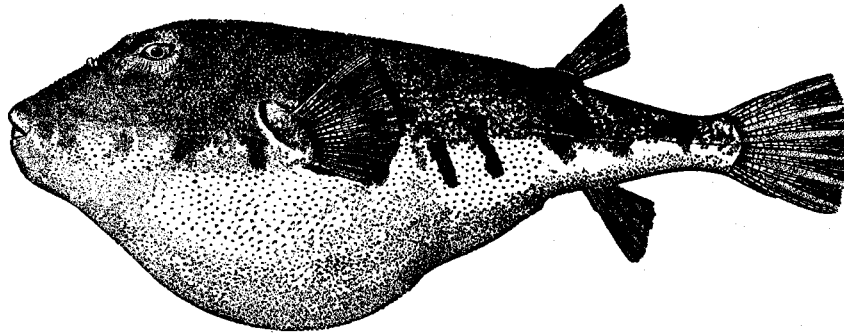


FIG. 209.—*Tetraodon maculatus*

Color in alcohol grayish to dark brown above; plain white underneath; most of the lighter colored specimens with spots darker than the ground color on the back; sides with a series of seven or eight vertically elongated dark spots from base of pectoral to base of caudal; frequently with one or two similar spots in advance of pectoral; many specimens with dark dots on side of head, these frequently extending back on side of body; fins all plain translucent. Color notes, taken in the field, of a living specimen 5 inches long, brownish above, with small green and black spots; white below; seven or eight irregular black bars along sides posterior to pectoral, and a black spot in front of pectoral; a dark brownish area at base of dorsal and another between dorsal and caudal; dorsal and anal plain; caudal yellow brown; pectoral pale yellowish brown.

Many specimens of this species, ranging in length from 25 to 260 millimeters (1 to 10¼ inches) were preserved. The young do not differ greatly from the adults. This puffer differs conspicuously from its relative, *T. testudineus*, in the absence of reticulating light lines on the back and sides and in the presence of a series of vertically elongate dark spots on the sides.

The food, according to 22 specimens examined, consists principally of small crustaceans, including crabs, shrimp, isopods, and amphipods. A few small mollusks, annelids, and traces of algæ also were present. Examinations for food made by Linton (1905, p. 402) at Beaufort, N. C., and Welsh and Breder (1922, p. 273) at Atlantic City, N. J., indicate that although other invertebrates enter into the food, small crustaceans predominate.

Ripe or nearly ripe fish were taken in Chesapeake Bay during May. Ripe males as small as 140 millimeters (5½ inches) were taken May 17 at Crisfield. Eggs apparently are produced in very large numbers. It is estimated that the ovaries of one specimen 265 millimeters (10½ inches)

in length contained 176,000 eggs, all of uniform size. Welsh and Breder,²⁰ working at Atlantic City, N. J., took ripe females from July 30 to August 27. The eggs are described as transparent, spherical, demersal, and adhesive. In diameter they vary from 0.85 to 0.91 millimeter. Incubation occupies about 3 days and 10 hours at an average temperature of 67° F. The newly hatched larvæ are about 2.41 millimeters in length. By the time the young fish reach a length of 7.35 millimeters they already have many of the characters of the adult.

The two smallest puffers (each 1 inch in length) in the collection were seined on August 9 at Point Patience, lower Patuxent River. Sizes ranging from over 1 to nearly 4 inches are absent from our collection. In the fall large numbers of puffers from 4 to 10 inches long are caught in the lower parts of the bay, and these fish apparently are of various ages. One haul, made on October 2, consisted of 175 puffers, 117 to 163 millimeters ($4\frac{1}{2}$ to $6\frac{1}{2}$ inches) long, the predominating lengths being 140 to 150 millimeters ($5\frac{1}{2}$ to 6 inches).

This puffer is taken in the Chesapeake from April to November, being most abundant in the catches during the spawning season in May and again in September and October. It is caught chiefly with hook and line, pound nets, and haul seines.

The species is said to attain a length of 14 inches but seldom exceeds 10 inches. It is quite abundant in the southern part of Chesapeake Bay, as well as elsewhere on the Atlantic coast from Cape Cod, Mass., southward, but it has no commercial value.

Habitat.—Portland, Me., to Florida; the only species of puffer abundant outside of the Tropics.

Chesapeake localities.—(a) Previous records: St. Marys River and St. Georges Island, Md., and Cape Charles city, Va. (b) Specimens in collection: From many localities from Love Point, Md., southward to the capes.

197. *Tetraodon testudineus* Linnæus. Puffer; Swellfish.

Tetraodon testudineus Linnæus, Syst. Nat., ed. X, 1758, p. 332. Type locality missing.

Chilichthys testudineus Lugger, 1877, p. 59.

Spheroides testudineus Jordan and Evermann, 1896-1900, p. 1734, Pl. CCLXV, figs. 646 and 646a.

Head 2.4 to 2.8; depth 3.15 to 4; D. 7 or 8; A. 6 or 7. Body robust; head rather broad; snout moderately long, 2 to 2.8 in head; eye 3.85 to 6.1; interorbital 4.6 to 8, more or less concave; skin with small prickles on back and somewhat larger ones on chest and abdomen; snout and tail smooth; no cirri; lateral line evident; dorsal and anal fins similar, the anal, however, somewhat smaller, its origin under posterior part of dorsal; caudal fin slightly convex; pectoral fins short and broad, 2 to 2.5 in head.

Color of back dark brown, broken on sides and becoming lighter; sides with black spots; the back and sides with narrow light lines forming reticulations; belly pale; caudal fin sometimes dusky; other fins pale greenish.

No specimens of this puffer were secured. The foregoing description is based on published accounts. The species is included because of a record by Lugger dating back to 1877. It has not been seen in the Chesapeake by other collectors. This fish is readily distinguished from its relative, *T. maculatus*, by the presence of light lines, forming reticulations on the back and sides, which *T. maculatus* does not possess.

This fish reaches a maximum length of about 10 inches. It has no commercial value.

Habitat.—Woods Hole, Mass., to Natal, Brazil; very common in the West Indies and on the Atlantic coast of Panama; very rare in the northern part of its range.

Chesapeake localities.—(a) Previous record: "A single fine specimen was obtained in the southern part of the Chesapeake Bay" (Lugger, 1877). (b) Specimens in collection: None; evidently extremely rare in Chesapeake Bay.

Family XCI.—DIODONTIDÆ. The porcupine fishes

Body short, depressed above; belly moderately inflatable; mouth moderate; terminal; jaws with continuous bony plates, having no median suture; nostril usually with a short tube with two lateral openings; gill-openings consisting of more or less vertical slits, placed in front of pectorals; body almost everywhere with bony spines; dorsal and anal fins similar, placed posteriorly and mostly opposite each other; caudal fin round; ventral fins wanting; pectoral fins short and broad.

* For a detailed account of the embryology and larval development of this puffer see Welsh and Breder, Zoologica, Vol. II, No. 12, 1922, pp. 261 to 276, figs. 80 to 96. New York.

KEY TO THE GENERA

- a. Body with slender, sharply pointed, movable spines..... *Diodon*, p. 350
 aa. Body with shorter, less sharply pointed, immovable spines..... *Chilomycterus*, p. 350

156. Genus *DIODON* Linnæus. Porcupine fishes

Body robust, inflatable; head short, broad; teeth in both jaws with a continuous cutting edge, no median suture; nasal tube simple, with two lateral openings; body everywhere with strong, pungent spines; dorsal and anal similar, posteriorly inserted; caudal fin round; ventral fins wanting; pectoral fins broad, the posterior margin truncate, the upper lobe longest. A single widely distributed species was once recorded from Chesapeake Bay.

198. *Diodon hystrix* Linnæus. Porcupine fish.

Diodon hystrix Linnæus, Syst. Nat., ed. X, 1758, p. 335; India. Uhler and Lugger, 1876, ed. I, p. 85; ed. II, p. 71; Jordan and Evermann, 1896-1900, p. 1745, Pl. CCLXVI, fig. 648.

? *Trichodiodon pilosus* Uhler and Lugger, 1876, ed. I, p. 87, ed. II, p. 72.

Head 2.2 to 2.4; depth 2.45 to 3; D. 13 or 14; A. 12 or 13. Body robust, rather broader than deep when not inflated; head depressed, notably broader than deep; snout very short, 2.8 to 3.1 in head; eye 2.85 to 3.45; interorbital very broad concave, 1.4 to 1.5; mouth rather broad; gill slit not longer than eye; skin thickly beset with strong sharp spines, longest on top of head, back, and sides; dorsal and anal fins similar, placed far back, the dorsal beginning somewhat in advance of the anal; caudal fin round; pectoral fins broad, the upper rays longest, 1.65 to 2.33 in head.

Color dusky above, white below, entire body and fins marked by small round spots.

This porcupine fish was not seen during the present investigation. It is included because of a record dating back to 1876 (Uhler and Lugger, 1876). The fish has not been seen in Chesapeake Bay by more recent investigators. The foregoing description is based upon published accounts of the species. The porcupine fish is readily recognized by the long, sharply pointed, movable spines, which cover nearly the entire body.

Although this fish has been known to science for several centuries and from many parts of the world, we are unable to find information relative to its feeding and breeding habits. The species is said to reach a length of 3 feet. It is regarded as a curiosity by many and is rather extensively sought by travelers. Mounted specimens are common in nearly all museums. The species apparently has no value as food.

Habitat.—All warm seas; northward on the American coast to Massachusetts; uncommon north of Florida.

Chesapeake localities.—(a) Previous record: In Chesapeake Bay off the southern extremity of St. Mary's County, Md. (Uhler and Lugger, 1876). (b) Specimens in collection: None; apparently very unusual in Chesapeake Bay.

157. Genus *CHILOMYCTERUS* Bibron. Bur fishes

Body broad, depressed, more or less inflatable; nasal tube simple, with two lateral openings; teeth in the jaws without median suture; dermal spines with three roots, immovable, triangular; caudal peduncle short. A single species is known from Chesapeake Bay.

199. *Chilomycterus schœpfi* (Walbaum). Bur fish; Spiny toadfish; Thorny toad.

Diodon schœpfi Walbaum, Arted. Pisc., 1792, p. 601; Long Island, N. Y.

Chilomycterus geometricus Uhler and Lugger, 1876, ed. I, p. 86; ed. II, p. 72.

Chilomycterus sp. Bean, 1891, p. 83.

Chilomycterus schœpfi Jordan and Evermann, 1896-1900, p. 1748, Pl. CCLXVI, fig. 649; Evermann and Hildebrand, 1910, p. 162.

Head 2.1 to 2.75; depth about 3 or 4 (when not inflated); D. 11 or 12; A. 10. Body robust, somewhat broader than deep; head short, broad; snout very short and broad, 2.15 to 2.35 in head; eye 3.8 to 4.5; interorbital broad, concave, 1.45 to 1.75; mouth small, terminal; teeth in a continuous plate in each jaw; scales wanting; skin everywhere, except on caudal peduncle, with more or less compressed three-rooted spines; two spines over orbit; one on middle of forehead;